Ocean Data Management at NCDC

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1. PROJECT SUMMARY

There are two elements covered by this project. The first one is to develop a sea surface wind product. The second is to improve access to the surface marine archive of the International Comprehensive Ocean-Atmosphere Data Set (ICOADS).

Objectives: The two objectives for this project are:

1) To develop and improve a globally gridded blended high resolution sea surface wind product from multiple satellites from several US agencies and to make this research product operational.

2) To provide access to ICOADS data, for the full period of record (1854-present), via NCDC's Climate Data Online (CDO) system. Also, to provide access via NCDC's Geographic Information System (GIS) services.

Both projects support NOAA/NCDC Goal 2 - provide the highest feasible data quality and information. They also support NCDC Goal 3 activities #6) - U. S. Integrated Earth Observation System (USEOS) and #7) - Global Earth Observation System of Systems (GEOSS). Additionally, they support cross NOAA-NASA-DoD activities.

2. FY 2006 ACCOMPLISHMENTS

1) Blended High Resolution Global Sea Winds

Present Global Ocean Observing System (GOOS) consists of multiple platforms and instruments. Each of these observations contributes to the understanding and assessment of climate change signals. However, individual instrument observations have limitations in coverage (in both time and space) and limitations on accuracy. To maximize benefits and integrally use all the available observations, blending of them together is necessary to produce higher resolution and higher accuracy products. For example, research on global water and energy budgets and numerical weather and ocean forecasts demand increasingly higher resolution forcing data (better than daily and 50 km; e.g., WMO/TD-No. 1036, 2000; Curry et al. 2004). Thus an effort to produce globally gridded high resolution products for the sea surface wind speed has been started at NCDC. (Separate high resolution blended products for sea surface temperature are also being produced at NCDC and partially funded by NOAA/CPO/OCO.)

We first assessed the feasibility of producing gridded products for various resolutions from all available wind speed observations. Given the dense satellite data coverage, in-situ data play minor role in the blended products to reduce random and sampling errors and to increase resolutions, thus were not considered so far. However, in-situ data play an essential role to correct systematic satellite biases, and they will be used in the future in this regard for improvement.

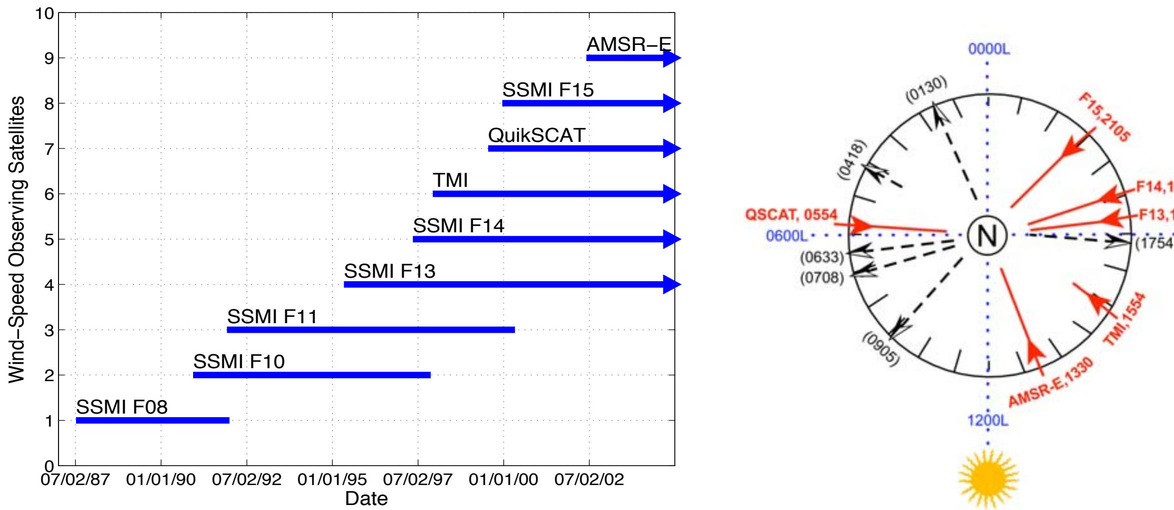

Figure 1 a) Timeline of the long-term US sea surface wind speed observing satellites (left panel); and b) Typical satellite tracks since mid 2002 (right panel). This is a simplified view from the North Pole in Local Solar Time. Red/solid lines represent ascending tracks; black/dashed lines represent descending tracks.

Sea surface wind speed observing satellite number has been increased from one in late 1987 to more than six since June 2002 (Figure. 1). These satellites are operated by NOAA, NASA and DOD. Detailed assessment (Table 1; Zhang et al. 2006) showed that for a global spatial grid of 0.25º, blended products with temporal resolutions of 6-, 12- and 24-hours have become feasible since mid 2002, mid 1995 and January 1991, respectively (Table 1). The corresponding feasible times can be farther extended back to the beginning of 2000 and 1991 and late 1987 when the minimum spatial coverage was reduced to 65%, 70% and 75%, respectively.

Table 1. Typical percentages of the global 0.25º oceanic boxes between 65ºS – 65ºN in which there are data coverage 75% of the time or better for the specified time resolutions (1st column) and as functions of time (indicated by the top row). The whole time period is classified into six stages corresponding to the typical number of available satellites. The time periods with ≥ 90% spatial coverage and ≥75% temporal coverage are highlighted by shading.

Time period & satellites / Time resolution	JUL1987→ I F08	JAN1991→ II F10, F11	JUN1995→ III F10, F11, F13	JAN1998→ IV F11,F13, F14 TMI	JAN2000→ V F13, F14, F15 TMI, QSCAT	JUN2002→ VI F13, F14, F15 TMI, QSCAT AMSR-E
6-hourly	12	26	42	56	66	91
12-hourly	27	72	97	99	100	100
Daily	75	100	100	100	100	100

From the above statistics and for an initially uniform blending for the whole sea wind satellite era (July 1987 – present), a 12-hourly time window was chosen for the first blended product. Sub-sampling aliases may still be large in the early few years but data are abundant for the later years (Table 1). Taking the advantage the latter year's dense sampling, blended data were generated 4 times a day at 00, 06, 12 and 18Z. To avoid heavy smoothing for instantaneous product, a Gaussian-like weighting in both time and space was used (Zeng and Levy 1995). The 6-hourly 0.25º gridded data and data production details are available at http://www.ncdc.noaa.gov/oa/rsad/blendedseawinds.html. Products of daily and monthly are also available and are simple averages of the 6-hourly data, and operationally updated each quarter.

To make the data available to a wider user community, they are served in multiple data formats, including the netCDF that can be served through inter-operable data servers for different levels of users. For example, through an "One-NOAA" approach and to provide streamlined services across different NOAA Goal Teams (Ecosystem and Climate) and Line Offices (NESDIS and NMFS), NCDC and the Environmental Research Division (ERD) of NMFS Southwest Fisheries Science Center started a pilot project for inter-operable data analysis and visualization and web services. This collaborative project leverages the products and resources at NCDC and ERD to provide value-added services. Through the distributed access and inter-operable data server at NCDC, ERD can acquire the NCDC data "on-the-fly" by web browsing, sub-setting, visualization and disseminating to users in user-preferred formats (images, text or binary data, etc.); shown in Figure 2 is in a global image. The "Live Access Severs" are available at both ERD and NCDC: http://las.pfeg.noaa.gov/las6_5/servlets/dataset?catitem=20; http://nomads.ncdc.noaa.gov:8085/las/servlets/dataset?catitem=731.

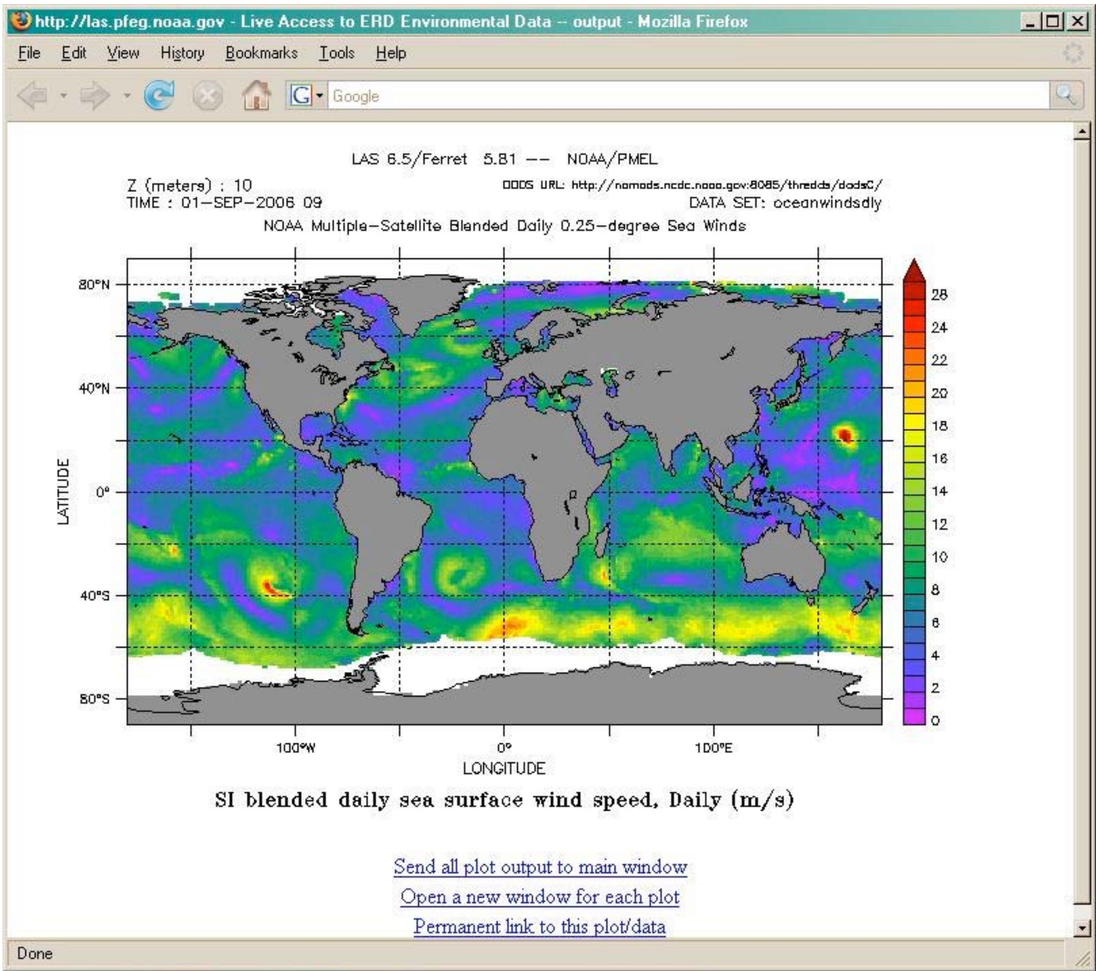

Figure 2 An example of blended global sea winds on 1 September 2006, with a typhoon in the west Pacific Ocean clearly shown. The data reside on an inter-operable data server at NCDC in Asheville, NC, and were acquired and displayed "on-the-fly" by the "Live Access Server" (LAS) at the fisheries lab in Monterey, CA.

2) ICOADS Data Access

During FY06, data access accomplishments focused on four main areas:

a) Marine data consists of several "raw" formats including WMO Ships' Synoptic Code (FM 13-X); Coastal-Marine Automated Network (C-MAN FM12); Drifting Buoy (FM18). All formats are converted to ICOADS, archived, and made available to the web based online system ("Climate Data Online" - CDO) for public access.

b) The relational data model (in Oracle) was completed, to allow for easy retrieval of the data via CDO. This also includes the keys and indices needed within Oracle, to support fully automated retrieval processes. Then, the data were "pulled" from the NCDC digital archive and loaded into the relational database. Also, online data are updated monthly with the latest available data for the current year.

c) Initially, 2005-2006 data were placed online for public access. (Note that the data are available free of charge to all customers/users.) Data prior to 2005 will be made available online in the near future, after some additional quality control is applied. Customers are now able to retrieve the ICOADS marine data online, rather than placing orders for off-line delivery as done in the past.

d) The CDO software development was completed, to allow customers to request their desired data via latitude/longitude area, ship/buoy ID, and time period. Also, the CDO system provides several data format options, such as the "common marine format" used for many years. The CDO development team worked extensively with NCDC's Customer Services Branch to ensure user requirements fully met.

3. PUBLICATIONS/REPORTS

Zhang, H.-M., J.J. Bates, and R.W. Reynolds, 2006: Assessment of composite global sampling: sea surface wind speed. *Geophysical Research Letters*, 33, L17714, doi:10.1029/2006GL027086, Vol. 33 (17).

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4. REFERENCES

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Zeng, L., and G. Levy (1995), Space and time aliasing structure in monthly mean polar-orbiting satellite data, *J. Geophys. Res*., *100 (No. D3)*, 5133-5142.
Zhang, H.-M., J.J. Bates, and R.W. Reynolds, 2006: Assessment of composite global sampling: sea surface wind speed. *Geophysical Research Letters*, 33, L17714, doi:10.1029/2006GL027086, Vol. 33 (17).